

TABLE OF CONTENTS ~ HAUNCHES

5.3	Haunches
5.3.1	General
5.3.1.1	Policy overview
5.3.1.2	Design information
5.3.1.3	Definitions
5.3.1.4	Abbreviations and notation
5.3.1.5	References
5.3.2	PPCB bridges
5.3.2.1	Analysis and design
5.3.2.2	Detailing
5.3.3	CWPG bridges
5.3.3.1	Analysis and design
5.3.3.2	Detailing
5.3.4	RSB bridges
5.3.4.1	Analysis and design
5.3.4.2	Detailing

5.3 Haunches

5.3.1 General

For continuous welded plate girder (CWPG) and rolled steel beam (RSB) bridges, haunch design is directly related to lengths of shear studs that are welded to the top flanges of the girders or beams. When designing the haunches for steel bridges the designer should consult office policy for shear studs [BDM 5.5.1.4.1.8] in addition to the haunch policies in following articles.

5.3.1.1 Policy overview

For pretensioned prestressed concrete beam (PPCB), continuous welded plate girder (CWPG), and rolled steel beam (RSB) bridges the office typically uses a variable concrete haunch thickness at each beam or girder to fit the roadway surface to the top profiles of the beams or girders. The design haunch is used in determining the beam or girder seat elevations and the estimated deck concrete quantity.

The designer should set haunch thicknesses inside the minimum design limit at edge of beam or girder and maximum design limit at centerline of beam or girder, with consideration of shear steel, so that the contractor will have tolerances for both upward and downward adjustments in the field.

In the field the contractor will set the beams or girders on the bearings at the beam seats and will survey the tops of beams or girders at the intervals given on the “Slab Haunch Data Details” sheet [OBS SS 1066] or, for RSB bridges, the “Beam Line Haunch Data” standard sheet selected for the bridge length [OBS SS 5264, 5267, etc.]. Then the contractor can subtract the survey elevations from the beam line haunch elevations given on the sheet to determine the haunch thicknesses for setting the deck forms.

If limits given on the plans for haunch are exceeded in the field, the Resident Construction Engineer (RCE) may reset the profile grade to adjust to the differing as-built conditions. If the grade adjustment is not practical for a PPCB bridge, thick haunches may be reinforced with additional bars so that the beam stirrups are extended a minimum of 2.5 inches (65 mm) into the deck. If the grade adjustment is not practical for a CWPG or RSB bridge, the office will address the haunch problem on a case-by-case basis.

5.3.1.2 Design information

Reserved

5.3.1.3 Definitions

Reserved

5.3.1.4 Abbreviations and notation

CWPG, continuous welded plate girder

PPCB, pretensioned prestressed concrete beam

RCE, Resident Construction Engineer

RSB, rolled steel beam

5.3.1.5 References

Reserved

5.3.2 PPCB bridges

5.3.2.1 Analysis and design

The designer should stay at least 0.5 inch (13 mm) within the maximum haunch of 3.5 inches (90 mm) at centerline of beam and -0.5 inch (-13 mm) at edge of beam. These field limits will be given for the contractor in a note on the plans.

The maximum and minimum haunch limits may, however, be controlled by shear steel heights. The minimum shear steel clearance from top of deck is 2.5 inches (65 mm), which may control minimum haunch, and the minimum shear steel embedment into the deck is 2.5 inches (65 mm), which may control maximum haunch. For A through D beams, standard shear reinforcement extends 4.5 inches (115 mm) above the top flange, and for BTB through BTE beams, shear reinforcement extends 5 inches (125 mm) above the top flange.

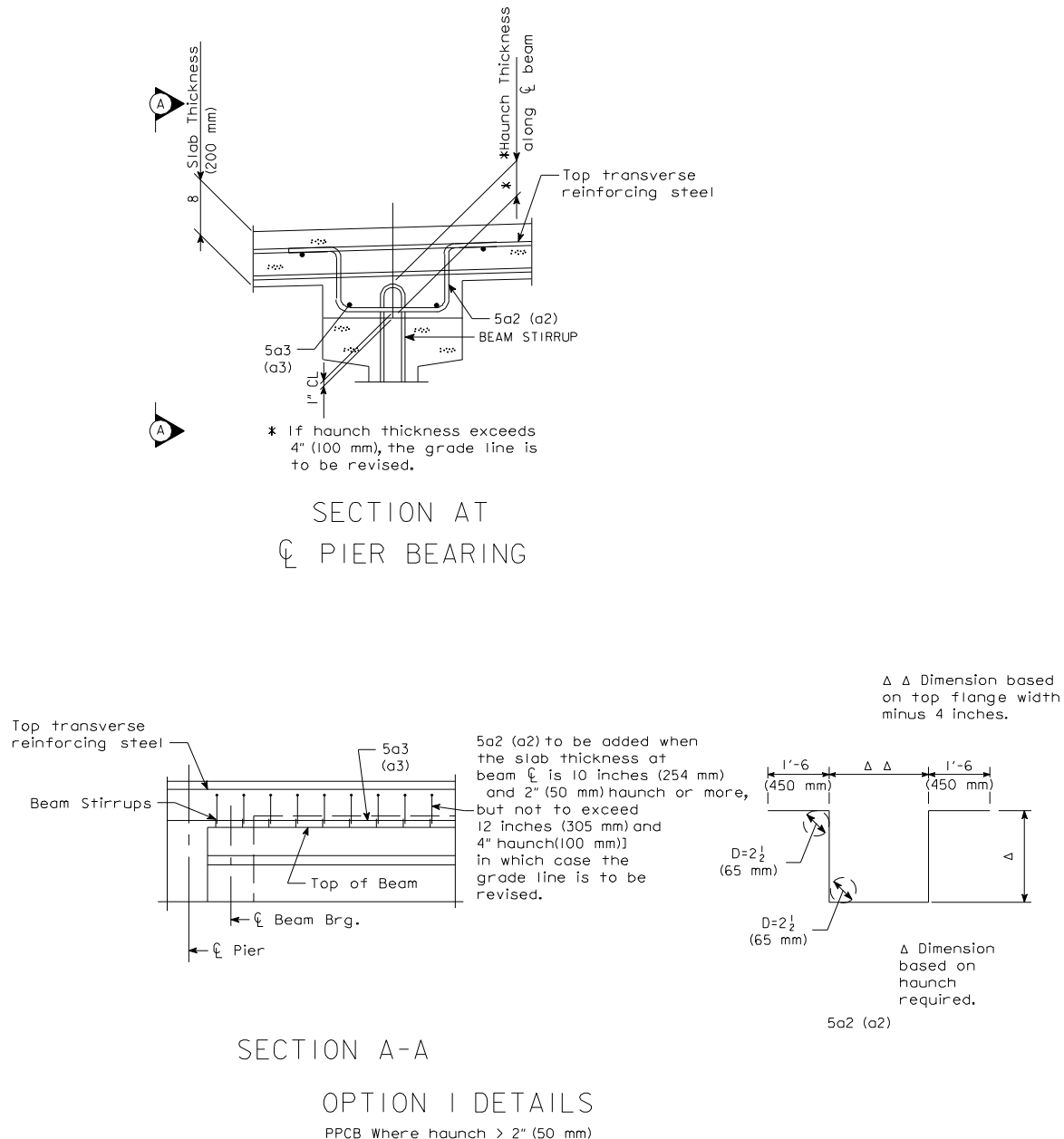
To start, set the minimum design haunch at 0.5 inch (13 mm) at centerline of beam but not less than 0.0 inch (0 mm) at edge of top flange after cross slope is considered. During construction the contractor then will have 0.5 inch (13 mm) tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire beam line.

Check the minimum and maximum haunches based on shear steel heights. When checking the maximum haunch, the designer need not consider any cross slope or superelevation that increases the haunch at the edge of the deck. The maximum haunch should not exceed 3.0 inches (75 mm) so that the contractor has 0.5-inch (13-mm) tolerance for maximum haunch in the field. Modify the bridge seat elevations as necessary to attempt to fit within the haunch limits.

If the haunch at the beam centerline exceeds the maximum because of beam camber and grade considerations, the designer has the following two options. Option 1 is the preferred option when the maximum haunch is at midspan, and Option 2 is the preferred option when the maximum haunch is at the beam ends.

- Option (1) Provide additional 5a2 and 5a3 (a2 and a3) bars with the deck reinforcing to adequately reinforce the haunch where it exceeds 2.0 inches (50 mm) as shown in Figure 5.3.2.1.

**Figure note:**

- The 5a2 (a2) bars shall be epoxy coated.

Figure 5.3.2.1. Option 1 reinforcement for thick haunches on A-D beams

Option (2) Adjust the length of the beam shear reinforcement in the required areas to extend a minimum of 2.5 inches (65 mm) into the bottom of the bridge deck. For this option, the office prefers that the beam shear reinforcement details be symmetrical. It is preferable to use 0.5-inch (13-mm) increments in the height adjustment rather than a uniform variation. The minimum design clearance above the top of the beam shear reinforcement shall be 3.5 inches (90 mm) inches, which will minimize interference of the shear reinforcement with the top layer of reinforcement in the deck.

If after the adjustments the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.2.2 Detailing

The designer should provide the following information and haunch details for interior beams on the plans [OBS SS 1065]:

- “Beam Camber Data”,
- “Slab Thickness at Beams (T)”, and
- “Slab Thickness Details”.

In addition, the designer shall provide a plan sheet titled “Slab Haunch Data Details” [OBS SS 1066]. The purpose of the sheet is to provide beam line haunch elevations convenient for the contractor to use in setting field haunch. The designer determines the elevations by taking each beam line slab elevation, subtracting the deck thickness, and adding the theoretical immediate and long-term dead load deflection for the deck and diaphragms. In the field the contractor determines each haunch thickness by subtracting the surveyed top of beam elevation from the beam line haunch elevation on the plan sheet.

The “Slab Haunch Data Details” sheet includes the following:

- “Table of Beam Line Slab Haunch Elevations”;
- “Miscellaneous Data Table” for immediate and long term deflections of the slab and diaphragms, cross slope adjustments, and allowable field haunch;
- A note for “Haunch Locations”; and
- “Haunch Detail”.

In relatively complex PPCB bridges, the designer may need to provide the slab thickness at beams for all beam lines. The designer shall discuss the presentation of the information with the supervising Section Leader.

If a permissible closure pour is shown on the concrete placement diagram, the designer shall note that beam line haunch elevations need to be modified to accommodate the closure pour.

5.3.3 CWPG bridges

5.3.3.1 Analysis and design [AASHTO-LRFD 6.10.10.1.4]

Because camber can be cut into the web of a continuous welded plate girder (CWPG), the haunch can be relatively constant, and the design range is limited accordingly. For haunch design, the haunch thickness shall be 0-inch (0-mm) minimum measured at edge of flange and 2-inches (50-mm) maximum measured at centerline of girder.

The maximum and minimum haunch limits may, however, be controlled by shear stud heights. The minimum shear stud clearance from top of deck is 2.5 inches (65 mm), which may control minimum haunch, and the minimum shear stud embedment into the deck is 2.0 inches (50 mm) [AASHTO-LRFD 6.10.10.1.4], which may control maximum haunch.

To start, set the minimum design haunch at 0.5 inch (13 mm) at centerline of girder but not less than 0.0 inch (0 mm) at edge of the top flange after cross slope is considered. During construction the contractor then will have 0.5-inch (13-mm) tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire girder line. Changes in thickness of the top flange will affect shear studs, and therefore the changes need to be considered with respect to the haunch thickness shown on the plans.

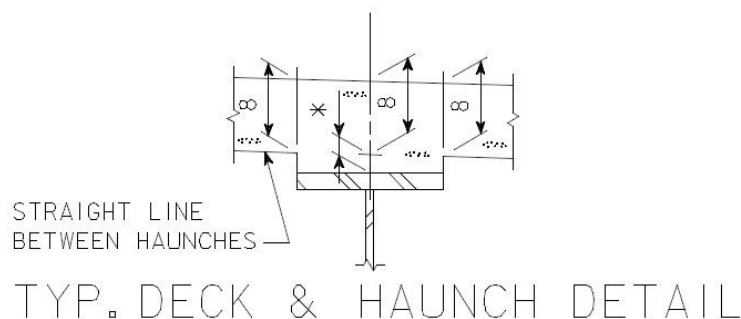
Check the minimum and maximum haunches based on shear stud heights. The maximum haunch should not exceed 2.0 inches (50 mm) so that the contractor has 1.5-inch (38-mm) tolerance for maximum

haunch in the field. Modify the bridge seat elevations, girder camber, and shear stud heights as necessary to fit within the haunch limits. If the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.3.2 Detailing

For typical CWPG bridges the designer should provide the following information and haunch details for interior girders on the plans. (See the example drawing in the commentary [BDM C5.3.3.2] and Figure 5.3.3.2.)

- “Beam Camber and Blocking Diagram”
- “Deflection Diagram”
- A table containing the following information:
 - Deflections due to concrete only (slab + haunch)
 - Total dead load deflection (slab + haunch + structural steel)
 - Top flange plate thickness, excluding bolted field splice plate thickness
 - Concrete haunch thickness, excluding top flange plate thickness and bolted field splice plate thickness



* CONCRETE HAUNCH DIMENSION MEASURED BETWEEN BOTTOM OF SLAB AND TOP OF TOP FLANGE PLATE.

THE MAXIMUM EMBEDMENT OF THE EDGE OF THE TOP FLANGE IN THE DECK SHALL BE $\frac{1}{2}$ INCH. SHEAR STUDS ARE TO HAVE A MINIMUM PENETRATION OF 2 INCHES INTO THE DECK AND BE AT LEAST $2\frac{1}{2}$ INCHES CLEAR OF THE TOP OF THE DECK. THESE REQUIREMENTS WERE USED IN SETTING THE MAXIMUM AND MINIMUM ALLOWABLE FIELD HAUNCH VALUES SHOWN IN THE “MISCELLANEOUS DATA TABLE” SHOWN ELSEWHERE ON THESE PLANS.

Figure 5.3.3.2. Typical slab and haunch detail and note [OBS SS 4305, 4308, 4309, and 4310]

In addition, the designer shall provide a plan sheet titled “Slab Haunch Data Details” [OBS SS 1066] with the following:

- “Table of Beam Line Slab Haunch Elevations”;
- “Miscellaneous Data Table” for deflections of the slab and haunch, cross slope adjustments, and allowable field haunch;
- A note for “Haunch Locations”; and
- “Haunch Detail”.

In relatively complex CWPG bridges, the designer may need to provide the deflection, girder fabrication, and theoretical haunch information in special tables and details. The designer shall discuss presentation of the information with the supervising Section Leader.

5.3.4 RSB bridges

5.3.4.1 Analysis and design [AASHTO-LRFD 6.10.10.1.4]

For a three-span rolled beam standard bridge the designer shall determine rolled beam haunch with respect to the dead load deflections given on the appropriate standard plan sheet [OBS RS40-061-10 to RS40-070-10].

The designer should stay at least 0.5 inch (13 mm) within the maximum haunch of 3.5 inches (90 mm) at centerline of beam and -0.5 inch (-13 mm) at edge of beam. These field limits will be given for the contractor in a note on the plans.

The maximum and minimum haunch limits may, however, be controlled by shear stud heights. The minimum shear stud clearance from top of deck is 2.5 inches (65 mm), which may control minimum haunch, and the minimum shear stud embedment into the deck is 2.0 inches (50 mm) [AASHTO-LRFD 6.10.10.1.4], which may control maximum haunch.

To start, set the minimum design haunch at 0.5 inch (13 mm) at centerline of beam but not less than 0.0 inch (0 mm) at edge of the top flange after cross slope is considered. During construction the contractor then will have 0.5-inch (13-mm) tolerance for minimum haunch.

Once the minimum is set, the haunch thickness can be checked along the entire beam line. Changes in beam depth will affect shear studs, and therefore the changes need to be considered with respect to the haunch thickness shown on the plans.

Check the minimum and maximum haunches based on shear stud heights. The maximum haunch should not exceed 3.0 inches (75 mm) so that the contractor has 0.5-inch (13-mm) tolerance for maximum haunch in the field. Modify the bridge seat elevations and shear stud heights as necessary to fit within the haunch limits.

If these modifications do not position the haunch within limits, consider camber but generally camber a beam only if the maximum haunch is greater than 2 inches (50 mm). Rolled beams can be cambered at the mill by cold cambering or at the fabrication shop by cold or heat cambering in accordance with the standard specifications [IDOT SS 2408.02, K].

If the haunch limits appear not to work for the project, the designer shall consult with the supervising Section Leader.

5.3.4.2 Detailing

For a three-span rolled beam standard bridge the designer should provide the following camber and haunch information on the plans with a standard "Misc. Details" sheet selected for bridge length [OBS SS 5252-5261]:

- "Beam Camber and Blocking Diagram"
- "Deflection Diagram"
- "Typ. Slab & Haunch Detail".
- A table containing the following information:
 - Deflections due to concrete only (slab + haunch)
 - Total dead load deflection (slab + haunch + structural steel)
 - Top flange plate thickness, excluding bolted field splice plate thickness
 - Concrete haunch thickness, excluding top flange plate thickness and bolted field splice plate thickness

The "Dead Load Deflection Diagram" is provided as a standard "Beam Deflections" sheet to be selected for bridge length [OBS RS40-061-10 to RS40-070-10].

In addition, the designer shall provide a plan sheet titled “Beam Line Haunch Data” [OBS SS 5264, 5267, etc.]. The sheet shall include the following:

- “Table of Beam Line Haunch Elevations”,
- “Miscellaneous Data Table”, and
- “Haunch Detail”.

Haunch locations are shown on the “Slab Elevations” sheet [OBS SS 5262 or 5263, 5265 or 5266, etc.] and need not be redrawn on the “Beam Line Haunch Data” sheet.